

CLAIMS

1. A system for enabling a distribution of fluids, comprising:
a substrate having a substrate body that includes a first substrate port and a second substrate port formed in a first surface and a first fluid passageway that extends in a first direction and fluidly connects the first substrate port to the second substrate port;
and
a manifold having a manifold body that includes a first manifold port formed in a first surface, a second manifold port formed in a second surface that is transverse to the first surface, and a fluid passageway that fluidly connects the first manifold port to the second manifold port;
wherein the substrate further includes a channel formed in the first surface of the substrate body that extends in a second direction, the channel being adapted to position the manifold so that the first surface of the substrate body and the first surface of the manifold body are aligned in a common plane.
2. The system of claim 1, wherein the first substrate port is adapted to receive a first fluid component and the second substrate port is adapted to receive a second fluid component that is distinct from the first fluid component.
3. The system of claim 2, wherein the first and second substrate ports are disposed on a first side of the channel, and wherein the substrate body further includes a plurality of mounting apertures formed in the first surface of the substrate body, the plurality of mounting apertures including at least one first mounting aperture disposed on the first side of the channel and at least one second mounting aperture disposed on a second side of the channel, the plurality of mounting apertures being arranged to mount the second fluid component in sealing engagement with the second substrate port and the first manifold port.
4. The system of claim 1, wherein the first and second substrate ports are disposed on a first side of the channel, the substrate body further including:
a third substrate port and a fourth substrate port formed in the first surface of the substrate body and disposed on a second side of the channel; and

a second fluid passageway extending in the first direction that fluidly connects the third substrate port to the fourth substrate port.

5 5. The system of claim 4, wherein the substrate body further includes a plurality of mounting apertures formed in the first surface of the substrate body, the plurality of mounting apertures including at least one first mounting aperture disposed on the first side of the channel and at least one second mounting aperture disposed on the second side of the channel, the plurality of mounting apertures being arranged to mount a fluid component in sealing engagement with the second and third substrate ports and the first manifold port.

15 6. The system of claim 5, wherein the plurality of mounting apertures includes no more than four mounting apertures, the four mounting apertures including two mounting apertures disposed on the first side of the channel and two mounting apertures disposed on the second side of the channel.

20 7. The system of claim 5, wherein at least one of the channel and the manifold body includes means for aligning the first manifold port with the second and third substrate ports.

8. The system of claim 4, wherein the first substrate port is adapted to receive a first fluid component and the second substrate port is adapted to receive a second fluid component that is distinct from the first fluid component.

25 9. The system of claim 8, wherein the third substrate port is adapted to receive the second fluid component and the fourth substrate port is adapted to receive a third fluid component that is distinct from the first and second fluid components.

30 10. The system of claim 9, wherein the substrate body further includes a plurality of mounting apertures formed in the first surface of the substrate body, the plurality of mounting apertures including at least one first mounting aperture disposed on the first side of the channel and at least one second mounting aperture disposed on the

second side of the channel, the plurality of mounting apertures being arranged to mount the second fluid component in sealing engagement with the second and third substrate ports and the first manifold port.

5 11. The system of claim 10, wherein the plurality of mounting apertures includes no more than four mounting apertures, the four mounting apertures including two mounting apertures disposed on the first side of the channel and two mounting apertures disposed on the second side of the channel.

10 12. The system of claim 10, wherein the substrate body further includes:
a fifth substrate port formed in the first surface of the substrate body and disposed on the first side of the channel;
a sixth substrate port disposed on the first side of the channel and formed in a second surface of the substrate body that is transverse to the first surface; and
15 a third fluid passageway extending in the first direction that fluidly connects the fifth substrate port to the sixth substrate port.

 13. The system of claim 12, wherein the first fluid component comprises a two port valve that is in fluidly connected to the first and fifth substrate ports.

20 14. The system of claim 13, wherein the second fluid component comprises a three port valve that is fluidly connected to the second and third substrate ports and the first manifold port.

25 15. The system of claim 14, wherein the second direction is perpendicular to the first direction.

 16. The system of claim 1, wherein the channel includes a pair of sidewalls and a base, and wherein the base of the channel includes an aperture through which a
30 rigid member can be inserted to remove the manifold from the channel.

17. The system of claim 16, wherein the aperture is threaded and is adapted to receive a threaded rigid member to remove the manifold from the channel.

18. The system of claim 1, wherein the substrate is a first substrate, the
5 system further comprising:

a second substrate having a second substrate body that includes a first substrate port and a second substrate port formed in a first surface of the second substrate body and a first fluid passageway that extends in the first direction and fluidly connects the first and second substrate ports of the second substrate;

10 wherein the second substrate further includes a channel formed in the first surface of the second substrate body that extends in the second direction and is adapted to position the manifold so that the first surface of the second substrate body and the first surface of the manifold body are aligned in the common plane.

19. The system of claim 18, wherein the manifold includes a third manifold port formed in the first surface of the manifold body that is fluidly connected to the fluid passageway of the manifold.

20. The system of claim 19, wherein the channel in the first substrate is
20 aligned, along the second direction, with the channel in the second substrate.

21. The system of claim 20, wherein:

the first and second substrate ports of the first substrate are disposed on a first side of the channel in the first substrate;

25 the first substrate body further includes a plurality of mounting apertures formed in the first surface of the first substrate body, the plurality of mounting apertures including at least one first mounting aperture disposed on the first side of the channel in the first substrate and at least one second mounting aperture disposed on a second side of the channel in the first substrate, the plurality of mounting apertures being arranged to
30 mount a first fluid component in sealing engagement with the second substrate port of the first substrate and the first manifold port;

the first and second substrate ports of the second substrate are disposed on a first side of the channel in the second substrate; and

the second substrate body further includes a plurality of mounting apertures formed in the first surface of the second substrate body, the plurality of mounting apertures including at least one first mounting aperture disposed on the first side of the channel in the second substrate and at least one second mounting aperture disposed on a second side of the channel in the second substrate, the plurality of mounting apertures being arranged to mount a second fluid component in sealing engagement with the second substrate port of the second substrate and the third manifold port.

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22. The system of claim 1, wherein the substrate is a first substrate and the manifold is a first manifold, the system further comprising:

a second substrate having a second substrate body that includes a first substrate port and a second substrate port formed in a first surface of the second substrate body and a first fluid passageway that extends in the first direction and fluidly connects the first and second substrate ports of the second substrate;

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a second manifold having a second manifold body that includes a first manifold port formed in a first surface of the second manifold body, a second manifold port formed in a second surface of the second manifold body that is transverse to the first surface of the second manifold body, and a fluid passageway that fluidly connects the first and second manifold ports of the second manifold;

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wherein the second substrate further includes a channel formed in the first surface of the second substrate body that extends in the second direction and is adapted to position the second manifold so that the first surface of the second substrate body and the first surface of the second manifold body are aligned in the common plane.

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23. The system of claim 22, wherein the first fluid passageway of the first substrate is aligned, along the first direction, with the first fluid passageway of the second substrate.

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24. The system of claim 22, wherein the first and second substrate ports of the first substrate are disposed on a first side of the channel in the first substrate, the first substrate further including:

5 a third substrate port and a fourth substrate port formed in the first surface of the first substrate body and disposed on a second side of the channel; and

a second fluid passageway extending in the first direction that fluidly connects the third substrate port to the fourth substrate port of the first substrate.

25. The system of claim 24, wherein the second substrate port of the first
10 substrate is adapted to receive a first fluid component and the fourth substrate port of the first substrate is adapted to receive a second fluid component that is distinct from the first fluid component.

26. The system of claim 25, wherein the first substrate body further includes a
15 first plurality of mounting apertures formed in the first surface of the first substrate body, the first plurality of mounting apertures including at least one first mounting aperture disposed on the first side of the channel in the first substrate and at least one second mounting aperture disposed on a second side of the channel in the first substrate, the first plurality of mounting apertures being arranged to mount the first fluid component in
20 sealing engagement with the second and third substrate ports of the first substrate and the first manifold port of the first manifold.

27. The system of claim 26, wherein the first plurality of mounting apertures includes no more than four mounting apertures, the four mounting apertures including
25 two mounting apertures disposed on the first side of the channel and two mounting apertures disposed on the second side of the channel.

28. The system of claim 26, wherein:
the first substrate body further includes a second plurality of mounting apertures
30 formed in the first surface of the first substrate body and disposed on the second side of the channel in the first substrate, the second plurality of mounting apertures being

arranged to mount the second fluid component in sealing engagement with the fourth substrate port of the first substrate; and

the second substrate body further includes a third plurality of mounting apertures formed in the first surface of the second substrate body, the third plurality of mounting apertures being arranged to mount the second fluid component in sealing engagement with the first substrate port of the second substrate.

29. The system of claim 28, wherein the first fluid component comprises a three port valve, and wherein the second fluid component comprises a mass flow controller.

30. The system of claim 22, further comprising:
a third substrate having a third substrate body that includes a first substrate port and a second substrate port formed in a first surface of the third substrate body and a first fluid passageway that extends in the first direction and fluidly connects the first and second substrate ports of the third substrate;

wherein the third substrate further includes a channel formed in the first surface of the third substrate body that extends in the second direction and is adapted to position the first manifold so that the first surface of the third substrate body and the first surface of the first manifold body are aligned in the common plane.

31. The system of claim 30, further comprising:
a fourth substrate having a fourth substrate body that includes a first substrate port and a second substrate port formed in a first surface of the fourth substrate body and a first fluid passageway that extends in the first direction and fluidly connects the first and second substrate ports of the fourth substrate;

wherein the fourth substrate further includes a channel formed in the first surface of the fourth substrate body that extends in the second direction and is adapted to position the second manifold so that the first surface of the fourth substrate body and the first surface of the second manifold body are aligned in the common plane.

32. The system of claim 31, wherein the second direction is perpendicular to the first direction.

5 33. The system of claim 1, wherein the second direction is perpendicular to the first direction.

34. The system of claim 1, wherein at least one of the channel and the manifold body includes means for aligning the first manifold port with the second substrate port.

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35. The system of claim 1, wherein the channel includes a pair of sidewalls and a base, wherein at least one sidewall of the pair of sidewalls includes at least one first groove, and wherein the manifold includes at least one second groove, the system further comprising:

15 at least one pin to align the first and second grooves so that the first manifold port is aligned with the second substrate port.

36. The system of claim 35, wherein the at least one pin has a length that when inserted into the first and second grooves, does not extend above the common plane.

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37. The system of claim 1, wherein at least one of the first and second substrate ports includes means for detecting whether a leak free seal is achieved.

25 38. The system of claim 1, wherein the channel includes a pair of sidewalls and a base, wherein at least one sidewall of the pair of sidewalls includes at least one first recess extending into the base and having a first edge, and wherein the manifold includes at least one second recess terminating in a second edge that is complementary to the at least one first recess, the system further comprising:

30 at least one fastener to engage the first and second edges.

39. The system of claim 38, wherein the fastener does not extend above the common plane when engaged with the first and second edges.

40. The system of claim 1, wherein one of the manifold body and the channel
5 includes a pair of alignment apertures having a shape, and the other of the manifold body and the channel includes a pair of alignment posts having a shape that is complementary to the pair of alignment apertures, a depth of the respective apertures being greater than a height of the respective alignment posts.

10 41. The system of claim 40. wherein the pair of alignment apertures and the pair of alignment posts are constructed and arranged such that when mated, the first manifold port is aligned in the first direction with the second substrate port.

42. A substrate, comprising:
15 a substrate body;
a first port and a second port formed in a first surface of the substrate body;
a first fluid passageway formed in the substrate body and extending in a first direction that fluidly connects the first port to the second port;
a channel, formed in the first surface of the substrate body, that extends in a
20 second direction that is different than the first direction, the channel being adapted to position a manifold having a manifold body that includes a first port formed in a first surface of the manifold body, a second port formed in a second surface of the manifold body, and a fluid passageway that fluidly connects to the first port of the manifold to the second port of the manifold so that the first surface of the substrate body and the first
25 surface of the manifold body are aligned in a common plane.

43. The substrate of claim 42, wherein the first and second ports of the substrate are disposed on a first side of the channel.

30 44. The substrate of claim 43, wherein the substrate body includes a plurality of apertures formed in the first surface of the substrate body, the plurality of apertures including at least one first aperture disposed on the first side of the channel and at least

one second aperture disposed on a second side of the channel, the at least one first and second apertures being arranged to mount a fluid component in sealing engagement with the second port of the substrate and the first port of the manifold.

5 45. The substrate of claim 44, wherein the at least one first and second apertures are arranged to mount a two port valve in sealing engagement with the second port of the substrate and the first port of the manifold.

 46. The substrate of claim 43, wherein the substrate further comprises:
10 a third port and a fourth port formed in the first surface of the substrate body and disposed on a second side of the channel; and
 a second fluid passageway formed in the substrate body and extending in the first direction that fluidly connects the third port to the fourth port.

15 47. The substrate of claim 46, wherein the substrate body includes a first plurality of apertures formed in the first surface of the substrate body, the first plurality of apertures including at least one first aperture disposed on the first side of the channel and at least one second aperture disposed on a second side of the channel, the first plurality of apertures being arranged to mount a fluid component in sealing engagement
20 with the second and third ports of the substrate and the first port of the manifold.

 48. The substrate of claim 47, wherein the first plurality of apertures is arranged to mount a three port valve in sealing engagement with the second and third ports of the substrate and the first port of the manifold.

25 49. The substrate of claim 47, wherein the substrate further includes:
 a fifth port formed in the first surface of the substrate body and disposed on the first side of the channel;
 a sixth port disposed on the first side of the channel and formed in a second
30 surface of the substrate body that is transverse to the first surface; and
 a third fluid passageway extending in the first direction that fluidly connects the fifth port to the sixth port.

50. The substrate of claim 49, wherein the fluid component is a first fluid component, and wherein the substrate body further includes a second plurality of apertures formed in the first surface of the substrate and disposed about the first and fifth ports, the second plurality of apertures being arranged to mount a second fluid component in sealing engagement with the first and fifth ports of the substrate.

51. The substrate of claim 50, wherein:
the first plurality of apertures is arranged to mount a three port valve in sealing engagement with the second and third ports of the substrate and the first port of the manifold; and
the second plurality of apertures is arranged to mount a two port valve in sealing engagement with the first and fifth ports of the substrate.

52. The substrate of claim 50, wherein the substrate body further includes a third plurality of apertures formed in the first surface of the substrate body and disposed about the fourth port, the third plurality of apertures being arranged to mount a third fluid component to the fourth port.

53. The substrate of claim 52, wherein:
the first plurality of apertures is arranged to mount a three port valve in sealing engagement with the second and third ports of the substrate and the first port of the manifold;
the second plurality of apertures is arranged to mount a two port valve in sealing engagement with the first and fifth ports of the substrate; and
the third plurality of apertures is arranged to mount one of an inlet side and an outlet side of a mass flow controller to the fourth port.

54. The substrate of claim 42, wherein the channel includes means for aligning the first port of the manifold with the second and third ports of the substrate.

55. The substrate of claim 42, wherein the second direction is perpendicular to the first direction.

56. The substrate of claim 42, wherein the channel includes a pair of sidewalls and a base, and wherein the base of the channel includes an aperture through which a rigid member can be inserted to remove the manifold from the channel.

5 57. The substrate of claim 56, wherein the aperture is threaded and is adapted to receive a threaded rigid member to remove the manifold from the channel.

58. The substrate of claim 42, wherein the manifold body includes at least one first recess formed in the first surface of the manifold body terminating in an edge,
10 wherein the channel includes a pair of sidewalls and a base, and wherein at least one sidewall of the pair of sidewalls includes at least one first recess extending into the base and having a first edge that is complementary to the at least one first recess.

59. The substrate of claim 42, wherein the channel has a base that includes at
15 least one of an alignment post and an alignment aperture.

60. A gas panel, comprising:
a first gas stick having a first flow path including a first plurality of ports formed in a common plane;
20 a second gas stick having a second flow path including a second plurality of ports formed in the common plane; and
a first manifold having first and second ports formed in the common plane, the first port being fluidly connected to one port of the first plurality of ports of the first gas stick, and the second port being fluidly connected to one port of the second plurality of
25 ports of the second gas stick.

61. The gas panel of claim 60, further comprising:
a second manifold having first and second ports formed in the common plane, the first port of the second manifold being fluidly connected to two ports of the first plurality
30 of ports of the first gas stick that are distinct from the one port of the first gas stick, and the second port of the second manifold being fluidly connected to two ports of the

second plurality of ports of the second gas stick that are distinct from the one port of the second gas stick.

62. The gas panel of claim 61, wherein the second manifold is adapted to
5 receive a purge gas that can be selectively provided to either the first flow path or the second flow path.

63. The gas panel of claim 60, wherein the first and second gas sticks each
includes a first substrate having a channel in which the first manifold is received, the
10 channel being adapted to position the first and second ports of the first manifold in the common plane with the one port of the first and second gas sticks, respectively.

64. The gas panel of claim 63, wherein the first and second gas sticks each
includes a second substrate having a channel in which the first manifold is received, the
15 channel being adapted to position the first and second ports of the second manifold in the common plane with the two ports of the first and second gas sticks, respectively.

65. A manifold adapted to be received in a substrate having a substrate body
that includes first and second substrate ports formed in a first surface of the substrate
20 body, a first substrate fluid passageway extending in a first direction that fluidly connects the first and second substrate ports, and a channel formed in the first surface of the substrate body that extends in a second direction, the manifold comprising:

a manifold body;
at least one first manifold port formed in a first surface of the manifold body;
25 a second manifold port formed in a second surface of the manifold body that is transverse to the first surface of the manifold body; and

a manifold fluid passageway formed in the manifold body and extending in the second direction that fluidly connects the at least one first manifold port to the second manifold port;

30 wherein the manifold body is dimensioned to be positioned within the channel so that the first surface of the substrate body and the first surface of the manifold body are aligned in a common plane.

66. The manifold of claim 65, wherein the at least one first manifold port includes a plurality of first manifold ports formed in the first surface of the manifold body, each of the plurality of first manifold ports being fluidly connected to the manifold fluid passageway.

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67. The manifold of claim 66, further comprising:

a third manifold port formed in a third surface of the manifold body that is transverse to the first surface of the manifold body and parallel to the second surface of the manifold body, the third manifold port being fluidly connected to the manifold fluid passageway.

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68. The manifold of claim 67, wherein the manifold is a first manifold, wherein the second manifold port of the first manifold is adapted to mate with a manifold port of a second manifold, and wherein the third manifold port of the first manifold is adapted to mate with a manifold port of a third manifold, the first second and third manifolds forming a common manifold.

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69. The manifold of claim 68, wherein at least one side surface of the manifold body that is transverse to the first, second, and third surfaces of the manifold body includes means for aligning each of the plurality of first manifold ports with a respective port of a respective substrate.

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70. The manifold of claim 65, further comprising:

a third manifold port formed in a third surface of the manifold body that is transverse to the first surface of the manifold body and parallel to the second surface of the manifold body, the third manifold port being fluidly connected to the manifold fluid passageway.

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71. The manifold of claim 65, wherein the manifold is a first manifold, and wherein the second manifold port of the first manifold is adapted to mate with a manifold port of a second manifold to form and common manifold.

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72. The manifold of claim 65, wherein the second manifold port is adapted to mate with a flange that is fluidly connected to process fluid supply.

73. The manifold of claim 65, wherein at least one side surface of the manifold body that is transverse to the first and second surfaces of the manifold body includes means for aligning the at least one first manifold port with one of the first and second substrate ports.

74. The manifold of claim 65, wherein at least one side surface of the manifold body that is transverse to the first and second surfaces of the manifold body includes at least one groove that is adapted to receive a pin to align the at least one first manifold port with one of the first and second substrate ports.

75. The manifold of claim 65, further comprising at least one of an alignment aperture and an alignment post formed in a third surface of the manifold body that is parallel to the first surface and transverse to the second surface.

76. The manifold of claim 65, further comprising at least one recess that terminates in an edge formed in the first surface of the manifold body.

77. A mounting assembly, comprising:

a first member having a body, the body of the first member including a first surface facing a first direction and a second surface facing a second direction opposite to the first direction on opposing surfaces of the body of the first member, the second surface having an outer portion that includes a groove disposed adjacent a perimeter of the outer portion and a central portion that extends from the outer portion in the second direction;

a second member having a body, the body of the second member including a first surface facing the first direction and a second surface facing the second direction opposite to the first direction on opposing surfaces of the body of the second member, the second surface having a central portion and an outer portion that extends from the central portion and includes a groove disposed adjacent a perimeter of the outer portion,

the body of the second member further including a through hole that extends through the body from the first surface through the central portion of the second surface; and

a first fastener having a threaded shank that is dimensioned to be received within the through hole in the body of the second member and engage the central portion of the
5 second surface of the body first member.

78. The mounting assembly of claim 77, further comprising:

a first resilient member dimensioned to fit at least partially within the groove in the outer portion of the second surface of the body of the first member; and

10 a second resilient member dimensioned to fit at least partially within the groove in the outer portion of the second surface of the body of the second member.

79. The mounting assembly of claim 78, wherein the body of the first member

further includes an internally threaded hole in the central portion of the second surface,
15 and wherein the threaded shank of the first fastener is externally threaded and dimensioned to be received within the internally threaded through hole in the central portion of the second surface of the body of the first member.

80. The mounting assembly of claim 79, wherein the first and second

20 members are generally circular in shape.

81. The mounting assembly of claim 80, wherein the central portion of the second surface of the body of the first member is generally cylindrical in shape with a pair of opposing flat sides.

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82. The mounting assembly of claim 81, wherein the internally threaded hole in the central portion of the second surface of the body of the first member extends through the body of the first member from the first surface through the central portion of the second surface of the body of the first member.

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83. The mounting assembly of claim 78, wherein the first and second resilient members are formed from an elastomeric material.

84. A method of attaching a substrate to a mounting plate having a hole that extends through the mounting plate from a first surface of the mounting plate to a second surface of the mounting plate, comprising acts of:

- 5 positioning an upper mount subassembly on the first surface adjacent the hole
- and passing a central portion of the upper subassembly through the hole;
- positioning a lower mount subassembly on the second surface adjacent the hole
- so that the central portion of the upper mount subassembly is disposed within a central portion of the lower mount subassembly;
- fastening the lower mount subassembly to the upper mount subassembly; and
- 10 fastening the substrate to the upper mount subassembly.

85. The method of claim 84, wherein the upper mount subassembly comprises a first rigid member and a first resilient member, the first rigid member having a body that includes first and second surfaces disposed on opposite sides of the body, the second

15 surface having an outer portion that includes a groove disposed adjacent a perimeter of the outer portion and a central portion, forming the central portion of the upper mount subassembly, that extends from the outer portion, wherein the act of positioning the upper mount assembly includes an act of positioning the upper mount assembly so that the first resilient member fits at least partially within the groove between the first rigid

20 member and the first surface of the mounting plate.

86. The method of claim 85, wherein the lower mount assembly comprises a second rigid member and a second resilient member, the second rigid member having a body that includes first and second surfaces disposed on opposite sides of the body, the

25 second surface having a central portion forming the central portion of the lower mount assembly and an outer portion that extends from the central portion and includes a groove disposed adjacent a perimeter of the outer portion; and

wherein the act of positioning the lower mount assembly includes an act of positioning the lower mount assembly so that the second resilient member fits at least

30 partially within the groove between the second rigid member and the second surface of the mounting plate.

87. The method of claim 86, wherein the central portion of the second surface of the first rigid member includes an internally threaded hole;

5 wherein the body of the second rigid member includes a through hole that extends through the body of the second rigid member from the first surface through the central portion of the second surface; and

10 wherein the act of fastening the lower mount subassembly to the upper mount subassembly includes acts of passing an externally threaded shank of a first fastener through the through hole in the body of the second rigid member and into the internally threaded hole in the central portion of the second surface of the first rigid member.

88. The method of claim 87, wherein the internally threaded hole in the central portion of the second surface of the first rigid member extends through the body of the first rigid member to the first surface; and

15 wherein the act of fastening the substrate to the upper mount subassembly includes an act of passing an externally threaded shank of a second fastener through the substrate and into the internally threaded hole.